
TONGA EARLY WARNING SYSTEM HIGH FREQUENCY/RADIOINTERNET (HF/RANET) PROJECT



*Tonga Meteorological Service, Fu'amotu Airport, Nuk'ualofa
Photo: P. Lefale, MetService ©*

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Prepared for

Munich Re Foundation and Government of Tonga

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List of Acronyms

ABoM	–	Australian Bureau of Meteorology
EMWIN	–	Emergency Managers Weather Information Network
GTS	–	Global Telecommunication System
HF/RANET	–	High Frequency/RadioInternet
MetService	–	Meteorological Service of New Zealand Ltd
NEMO	–	National Emergency and Management Office of Tonga
NOAA	–	US National Oceanographic and Atmospheric Administration
TEARS	–	Tonga Early Warning HF/RANET Systems Project
TMS	–	Tonga Meteorological Service
VMS	-	Vava'u Meteorological Service

Acknowledgements

We were delighted to be able to provide assistance and continue our long association with the Tonga Meteorological Service (TMS) through this project. We wish to thank the Director, Mr. 'Ofa Fa'anunu and his staff for always welcoming our involvement in the project and being receptive to our technical advice.

We thank Mr. Maliu Takai, Manager, National Emergency and Management Office of Tonga (NEMO) for engaging us to undertake this work and for providing the vision of what he wished the project to achieve.

Finally, we wish to thank Munich Re Foundation for providing the financial resources through the Government of Tonga to enable this project to be undertaken. We are especially grateful to Mr. Thomas Loster, Chairman of Munich Re Foundation for his unwavering support, dedication and commitment to the project, without whom this project would not have been a major success.

Executive Summary

This report is the final in a series of reports on the Tonga **EARly Warning HF/RANET System Project (TEARS)** prepared by MetService. It describes the work carried out by MetService, the Tonga Meteorological Service (TMS) and the Tonga National Emergency and Management Office (NEMO) during the course of the project - May 2007 to August 2008. TEARS was commissioned by the Government of Tonga, with financial assistance from Munich Re Foundation, Germany. The following services and products were provided under TEARS;

- **HF/RANET Systems;** HF/RANET network made up of four systems were successfully installed throughout Tonga at the following locations;
 - NEMO head office, Nuku'alofa
 - TMS Head Office, Fu'amotu Airport, Nuku'alofa
 - Vava'u Meteorological Service office (VMS), Vava'u Airport and
 - Ha'apai Meteorological Service office, Ha'apai Airport
- **Training;** A TMS staff member attended a two weeks HF/RANET training course organised jointly by MetService, Australian Bureau of Meteorology (ABoM), United States National Oceanographic Atmospheric Administration National Weather Service (US NOAA NWS) and USAID in Melbourne, Australia, in November 2007. In-country training by MetService RANET engineer of TMS staff members on HF/RANET systems – installation, operation and maintenance.
- **In-country visits;** MetService staff visited Nuku'alofa in November 2007 and February 2008
- **Upgrade of the VMS;** Work completed include;
 - installation of the HF/RANET system
 - installation of a new Digital Automatic Rainfall recorder
 - installation of a single phase mobile standby generator
 - reconditioning of Stevenson screen
 - installation of a new EMWIN satellite receiver
 - replacement of faulty PTB220A digital barometer
 - on site training of local VMS staff
- **Toolkit;** Provision of a general purpose tool kit to TMS for ongoing maintenance of the equipment.

The success of TEARS has led to the Government of Tonga requesting three additional HF/RANET systems for Niuafou'ou, Niuatoputapu and Eua from MetService.

1 Introduction

1.1 Project brief

MetService was contracted by the Government of Tonga, via the TMS and NEMO, with financial assistance from Munich Re Foundation, Germany, to design and implement an early warning HF/RANET system project (TEARS) for Tonga. In response, MetService carried out an initial desk top technical evaluation in May 2007. The aim was to ascertain as far as practicable, the HF/RANET requirements for TMS and NEMO and to scope and cost out the project. The technical evaluation, reproduced as Appendix I to this report, formed the basis for TEARS.

1.2 Early Warning System for Tonga

The Government of Tonga, through TMS and NEMO, recognised the need to establish an HF/RANET network within Tonga with the aim of further enhancing and improving communications between their smaller offices in the outer islands and their head offices in the capital, Nuku'alofa. The network also would be used to transmit early warnings to local communities in the event of an impending hazard associated with tropical cyclones, tsunamis or other natural hazards. It would also be used as a backup to the public communications network if the latter is out of service during and immediately after a major hazard as such a tropical cyclone.

The network provides a two way email and low speed data communications system. It allows critical meteorological and other emergency data and warnings to be freely and reliably passed at minimal operating cost to TMS and NEMO as well as to local communities. One of the major advantages of the HF based system is that it also has the capability to communicate regionally through the RANET regional meteorological data network. This allows for continued transmission and reception of meteorological and other warnings in the event of failure or shut down of the commercial telecommunication links.

It is worth noting that in the case of most Pacific Islands that rely on satellite communications, these international satellite stations must be shut down when sustained wind speeds exceed 65 knots (hurricane force winds) to ensure safety of the expensive satellite antennas. This leaves many Pacific Islands without incoming or outgoing public communications. Both the TMS and NEMO on Tongatapu have operational Emergency Managers Weather Information Network (EMWIN) systems for reception of meteorological, tsunami, volcanic ash, earthquake and other warnings from the meteorological Global

Telecommunications System (GTS). These warnings can now easily be re-transmitted to remote communities via the RANET HF system.

The EMWIN system contains many categories of weather data products, with over 6,500 unique products. The current EMWIN data stream contains all generally available public products from the US NOAA NWS Telecommunications Gateway, including the following product categories:

Analysis

Environmental/Air Pollution, Hydrological/Marine, Surface, Miscellaneous

Climatic Products

Daily Surface, Monthly Surface, Miscellaneous

Forecasts

Aviation Terminal, Aviation Area, Flash Flood Guidance, Headwater Guidance, Hydrological, Iceberg, Local/Area, Miscellaneous, Public, Recreation/Travelers, River, Shipping Area

Images

GOES satellite

Miscellaneous

Civil Emergency Messages, Public Information Statements

Reports

Surface (METAR), Radar, Seismic, Synoptic, Hydrological River, Drifting Buoy, Ice

Severe Weather

Warnings, Watches, Summaries, Statements, Advisories

Warnings

Severe Thunderstorm, Tornado, River Flood, Lakeshore/Marine, Typhoon/Hurricane, Marine/Coastal Flood, Tsunami/Tide

2 Value of Observational data and Early Warning System

Tonga comprises a number of low lying islands and atolls scattered over a large oceanic area. Not surprisingly, meteorological measurements in Tonga are sparse by comparison to more densely populated parts of the world.

All meteorological stations in Tonga play vital roles in providing meteorological data on a daily basis to global weather and climate research, modelling and forecasting centres and data bases. Importantly, the data is also used regionally as input to aviation and weather forecasts upon which Tonga's agriculture, marine and tourist-focussed economy strongly depends.

During the Tropical Cyclone season, the data is used as input to global and regional models to forecast the formation, development and movement of tropical cyclones. When tropical cyclones are within the Tonga's vicinity, TMS observational network stations play a crucial role in providing information on cyclonic genesis, movements and strengths of the systems. An outage of any one of these stations during these events could be very detrimental.

On the other hand, it is also vital that any severe weather warnings or any other warnings reach the local communities on time so they can respond effectively and take necessary actions.

TEARS had both of these requirements in mind – (1) to transmit the meteorological observational data to global and regional modelling centres on time and (2) transmit warnings to local communities, particularly those on remote, isolated islands on time.

3 Project Objective

To design and implement HF/RANET systems in Tonga as described and recommended in the desk top technical evaluation project proposal (Appendix I).

4 Outputs/Outcomes

4.1 Work to be completed

The proposal sets out the work schedule for the project (Table 1) and equipment requirements (Table 2).

Table 1: Work schedule

Activity Schedule	Timeline	Milestone
Project approval	7 September 2007	Contract signed
Procurement of equipment	October/November 2007	HF/RANET systems secured
First Installation: Nuku'alofa	December 2007	First system installed
Second Installation: NEMO	December 2007	Second system installed
Third Installation: Vava'u	January 2008	Third system installed
First Project Review	January 2008	1 st progress report
Fourth Installation: Ha'apai	February 2008	Fourth system installed
Second Project Review	March 2008	2 nd and final progress report
Project completed	31 March 2008	Project completed.

Table 2: System components

Component	Quantity
HF radio transceivers	4
HF data modems	4
Watt Meter/Arrestors	4
HF Antenna	4
AC Power supply	4
Power wiring	4
Computer	4
Communications Software License	4
Toolkit	1
Batteries	4

4.2 Work completed

A number of unforeseen events led to the delay in the implementation of the project. These include; delays in finalising the contracts; some suppliers, both local and overseas (e.g. supplier of masts in Brisbane, Australia) of system components were unable to deliver the equipment; delay in shipment and Custom clearance, some of the components were not available locally as originally planned or if they were available, were extremely expensive and above all, lack of fully trained local technicians to install the systems. Nevertheless, the project was successfully completed before the beginning of the 2008-09 tropical cyclone season.

4.2.1 HF/RANET System, Nuku'alofa

Prior to MetService HF/RANET engineer's visit to Nuku'alofa in February 2008, MetService ordered and built some of the system components (e.g. masts), tested and calibrated some of the equipment in its engineering workshop in Wellington before shipment to Nuku'alofa. The testing/calibration process is to ensure all equipment meet strict MetService quality control standards. Electronic equipment is particularly prone to early malfunctioning when exposed to harsh maritime tropical and humid conditions like the case in Tonga.

To ensure local staff are familiar with the systems prior to installation, MetService, in collaboration with the Australian Bureau of Meteorology (BoM) and US NOAA National Weather Service (NWS)/US AID, organised a joint HF/RANET two weeks training course in Melbourne, Australia for Pacific and African countries. The Director of TMS, 'Ofa Faanunu, attended the course on behalf of Tonga. 'Ofa was later responsible for installing the system on Vava'u in July 2008.

Once all the equipment arrived in Tonga, MetService dispatched its telecommunication/RANET engineer, Garry Clarke to Nuku'alofa in February 2008. Garry with assistance from TMS and NEMO staff carried out the following work; component checks; repair MFJ Dummy/Local Wattmeter; purchase locally sourced components and installed the first two systems at the TMS office at Fu'amotu airport and the NEMO head office, in Nuku'alofa. A copy of Garry's trip report is reproduced as Appendix II to this report.

4.2.2 Vava'u Installation

The HF/RANET system for Vava'u was installed in July 2008 by TMS staff as part of the Vava'u Meteorological Station (VMS) upgrade project. A copy of the report by 'Ofa Fa'anunu, Director of TMS, is reproduced as Annex III to this report.

5 Summary of Findings and Recommendations

Although TEARS was not completed on time, the project was a major success. All the systems installed are now fully operational. The project also was instrumental in getting the Government of Tonga to upgrade the TMS Vava'u airport office. It also provided external and local training of TMS staff on installing, operating and maintaining HF/RANET systems. TEARS also led to an agreement between the Australian Bureau of Meteorology (ABoM) and MetService to install a back up HF/RANET regional hub in Wellington to enhance the services to South Pacific Islands, including Tonga.

The following services and products were provided under TEARS:

- Four HF/RANET systems installed in the NEMO head office, Nuku'alofa, TMS Head Office, Fuamotu Airport, Nuku'alofa, TMS office, Vava'u Airport, Vava'u; and Ha'apai Airport
- A TMS staff member attended a two weeks HF/RANET training course organised jointly by MetService, Australian Bureau of Meteorology, US NOAA and US AID, Melbourne, Australia in November 2007.
- In-country visits by MetService staff (Manager, International Cooperation and Development and HF/RANET Engineer) in November 2007 and February 2008
- In-country training of local technicians (TMS staff) by a MetService engineer in February 2008
- Upgrade of the TMS office at Vava'u airport by TMS, including installation of the HF/RANET system, new Digital Automatic Rainfall recorder, local staff training, purchase and installation of a single phase mobile standby generator, reconditioning of Stevenson screen unit, installation of a new EMWIN satellite receiver completed in August 2008.
- Replacement of faulty PTB220A digital barometer at TMS office, Vava'u airport
- Provision of a general purpose toolkit for the installation and ongoing maintenance of equipment and HF radio gear.
- 4 x Endurant G31DT Gelmaster Gel Cell batteries.
- 100m of stainless steel wire about 2.0 – 3.0mm outside diameter
- 32 x 2.0 – 3.0mm s/s wire rope grips

- 10m Red 8GA DC Power Cable
- 10m Black 8GA DC Power Cable

Recommendations;

1. Ensure all equipment are in air condition rooms at all times.
2. Urge the Government of Tonga to fund the additional systems for Niuafu'ou, Niuatoputapu and Eua.
3. Develop and implement a preventative maintenance visit programme for the HF/RANET systems in the outer islands
4. Regular preventative visits to be carried out prior to the beginning of each tropical cyclone season.
5. Secure spare parts.
6. TMS and NEMO to monitor the performance of the systems and report faults to MetService engineers.

6 APPENDICES

Appendix I: Tonga HF/RANET Project

1.0 Project Description

The Government of Tonga, through the Tonga Meteorological Service (TMS) and Tonga National Emergency and Management Office (NEMO) wishes to set up an HF radio data network to improve communications between the various island centres. The units would be available for either voice or data communications. It would also be use as backup system network when the public communications network may be out of service such as during and immediately after major severe weather events.

The proposed network would provide two way email and low speed data communications facilities to Tonga's meteorological stations and allow critical meteorological and other emergency data to be freely and reliable passed at minimal operating cost. These units would be grid to ensure reliability. The HF system would also have the capability of communication regionally through the RANET regional meteorological data network being implemented throughout the Pacific Islands with major nodes in Australia and New Zealand. This would allow continued transmission and reception of meteorological and other warning information in the event of problems with the public international links.

It should be particularly noted in most Pacific countries that rely on satellite communications, the international satellite stations must be shut down when wind speeds exceed 65 knots to ensure safety of the large satellite antennas. This leaves the countries without any incoming or outgoing public communications. Both the NEMO and TMS offices on Tongatapu have operational EMWIN systems for reception of meteorological, tsunami, volcanic ash, earthquake and other warnings from the meteorological global telecommunications system. These warnings could be re-transmitted via the RANET HF system.

2.0 Government of Tonga's requirements

NEMO and TMS have specified its requirements as follows:

2.1 Project location

Vava'u, Meteorological Office
Ha'apai, Meteorological Office

Tongatapu, main Meteorological office at the international airport
Nukualofa, National Disaster Office

2.2 System components

HF Radio Transceivers
HF data modems
Watt Meter/Arrestors
HF antennas
Antenna Mast
AC Power supply
Power wiring
Computer
Coms Software License

2.3 Power requirements

AC grid connected at all sites.

3.0 Proposed HF/RANET system and specifications

3.1 Site work

The proposal does not include or allow for pre-installation site works and related costs.

3.2 Installation

MetService will carry out the first installation at Nukualofa. All other installations will be carried out by TMS or CAA technician.

3.3 Freight

The proposal provides for freight from New Zealand to Nuku'alofa.

3.4 HF/RANET

MetService engineers will purchase the required HF equipment, components and related material and complete the pre-assembly, system testing and calibrations and other related work. A MetService engineer will travel to Nuku'alofa to provide on site training.

3.5 Training

A MetService technician will provide training at Nuku'alofa to a TMS or CAA technician in the system. We have allowed for one week for this.

3.6 Maintenance

Maintenance is not included.

3.7 Spares

No spares are included.

3.8 Tonga NEMO and Tonga Meteorological Service to provide

The following is not included in the proposal and is intended that the TMS provides these items at no cost to MetService.

- Suitable sites for all equipment.
- Site Agreement/Lease(s) (if any).
- All Environmental and Building Agreements/Consents (if any).
- Security fencing (if necessary).
- Any maintenance of site.
- Suitable staff for technical training at Nuku'alofa during the MetService engineer's visit.
- Receipt of the shipped equipment, customs clearances, and safe and suitable storage.
- Any import levies, taxes or similar.
- Freight of the equipment to other sites.
- Any TMS or CAA technician travel disbursements.
- All site work, installations and commissioning of HF/RANET systems.

3.9 Pricing

Item	Price (Euro)
HF/RANET systems complete with AC Power supply and other system components described above. Training at Nuku'alofa of TMS or CAA technician, expert services and travel disbursements for the MetService technician, freight costs to Nuku'alofa as proposed.	46,000.00
Outer islands installation	4,000.00
TOTAL	50,000.00

4.0 General

4.1 Terms of Supply

Purchase Order

4.2 Project initiation

On receipt of purchase order.

4.3 Payments

Issuing of Purchase order: 50% of total price

Completion of training: Balance of quoted total price.

4.4 Warranty

Warranty on third party equipment is as per the manufacturer's warranty. This is normally for the period of one year from the date of purchase on a "return to factory" basis.

MetService warrants its workmanship for the period of one year from commissioning for equipment and software that has not been covered under any manufacturer's warranty.

Implementation Plan

Activity Schedule	Timeline	Milestone
Project approval	7 September 2007	Contract signed
Procurement of equipment	October/November 2007	HF/RANET systems secured
First Installation: Nukualofa	December 2007	First system installed
Second Installation: NEMO	December 2007	Second system installed
Third Installation: Vava'u	January 2008	Third system installed
First Project Review	January 2008	1st progress report
Fourth Installation: Ha'apai	February 2008	Fourth system installed
Second Project Review	March 2008	2nd and final progress report
Project completed	31 March 2008	Project completed.

Appendix II: Tonga HF RANET Installation Report

(This report was prepared by Garry Clarke, International Operations Manager (IOM) and MetService HF/RANET engineer.)

Purpose

This one week visit to Tonga (February 2008) was scheduled under the Tonga RANET Project funded by the Munich Re Foundation. The purpose was to install the first two HF Email systems at the Met Office at Fua'amotu Airport and at the National Emergency Management Office (NEMO) in Nuku'alofa. These installations were also used to provide on site training to the TMS staff who will then be asked to install the other systems in Ha'apai and Vava'u.

Tasks Undertaken

Component Checks: unpack and check that everything had been delivered without damage and all items ordered were in fact supplied.

Repair MFJ Dummy/Load Wattmeter: One of the components when unpacked and checked was not functioning correctly with no meter indication. It was one of the MFJ Dummy Load/Wattmeters which had been sent directly from the manufacturer in the USA. On further inspection of this component after removing the cover a loose wire was discovered. This wire had in fact never been soldered to the circuit board during

manufacture and when soldered to its correct position the unit functioned as it should. This one must have slipped through quality control checks and a report as been sent to the supplier

Purchase Locally Sourced Components: The proposal calls for the purchase of the earthing components, antenna mounting hardware and backup deep discharge batteries locally. While the earthing components were readily found, after visits to a number of suppliers suitable deep discharge batteries were not obtainable as was suitable antenna mounting hardware. MetAService needs to purchase these items with suitable battery terminals and cables and send to Tonga. As the batteries are for backup operation when the mains fails this did not hinder the Tongatapu installation which are primarily mains powered and instruction was provided on how to install the batteries when these are provided. One other component was actually not considered for this project and that is a suitable kit of tools for the outer island installations. It was discovered upon my arrival that TMS and NEMO did not possess a single tool and for the Tongatapu installations I had to rely on my own small travelling tool kit and tools borrow from several sources. It is recommended that MetService purchased a tool kit for the installation of other systems. Purchasing in New Zealand and shipping with the batteries was the preferred option as the price of hardware and tools is extremely high in Tonga.

Fua'amotu Met Installation; Fortunately two tall tarmac lightning standards were situated in front of the Fua'amotu Met Office some 50 metres apart. One already was used as an anemometer mast as shown in Photo 1 below.



Photo 1: Lighting Standard outside Fua'amotu Met

As these lightning standards were ideal for installing the 48 metre HF antenna supplied the mast supplied was not needed. As mentioned suitable antenna mounting hardware could not be found and the antenna was attached to the lightning standards

using polypropylene rope purchased locally. This will be suitable for the short term until suitable antenna mounting hardware can be supplied. The radio components were connected together and the software loaded onto the locally purchased laptops. These laptops proved to be ideal for the application as did the antenna mounted between the lightning standards as communications between Fua'amotu Met Office and the Australian Bureau of Meteorology's HF Email server in Melbourne proved to be no trouble as were tests using Sailmail to Honolulu.

NEMO Installation; An antenna mast was not required for the NEMO installation and as there was already a suitable HF antenna on site and therefore the supplied antenna were not needed as well. The equipment had been pre-assembled and tested at the Fua'amotu Met Office prior to transporting to the NEMO Office in Nuku'alofa so installation was quick and communications both by HF Email and SSB voice was established and proved extremely reliable between these two centres (Photo 2).



Photo 2: NEMO RANET System in Communications Room

Training; A set of Installation and Usage Instructions were written over the weekend that was specific to the Tongan HF RANET Project. These written instructions formed the basis of the training provided to the meteorological staff who will carry out the outer island installations. This training was provided over two days mainly at the Met Office but also repeated at the NEMO office for NEMO staff to show how to use the system. The meteorological staff were able to successfully setup a system on their own that will be used at an outer island site. They also appeared confident to be able to do this during the actual installation.

Additional Requirements to Complete Installations; As indicated above some components necessary to complete the installations together with a suitable set of tools to enable meteorological staff to complete the outer island installation will need

to be purchased in New Zealand and shipped to Tonga. Four complete HF RANET stations were supplied but the original request was for six installations to include all Tongan Meteorological Offices but funding did not appear to be adequate for six stations so four have been supplied initially. As two masts and one antenna supplied were not required for the Tongatapu installations these can now form the starting components to assembly two more stations for the Niua's. The Director was very keen to have the stations on the Niua's included as collection of synoptic and climate data from these two remotest stations is difficult. If funds remain after the first four installations are complete the Director would like to have these applied to at least SSB voice radio systems for the Niua's and perhaps Tongan local funding or donor funding could be found to upgrade these to HF Email systems. Based on the two initial installations and HF propagation experienced and predicted the systems should be very suitable for Met operational and Emergency Management communications and improve the collection and dissemination of meteorological and climate data, forecasts and warnings from/to Tonga.

Appendix III: Vava'u Meteorological station upgrade project report

(This report was prepared by Mr. 'Ofa Fa'anunu, Director of TMS).

1.0 Executive Summary

As part of the overall upgrade of meteorological services in the Kingdom to provide meteorological services to all sectors the Vava'u Meteorological Station was upgraded from 11 June to 11 July 2008. The works include the following:

1. Re-furbishing of a new office space about 60m west of the main terminal building at Lupepau'u Airport
2. Transferring of all meteorological equipment and instruments from the old location at the Control Tower to the new office
3. Installing of a new HF Voice/Data radio at the new site as primary communications to Met Headquarters in Fua'amotu and the National Disaster Office
4. Installing a new Digital Barometer for measuring MLSP and QNH for Lupepau'u Aerodrome
5. Installing a new Digital Automatic Rainfall recorder on the Eastern District (Tu'anekevile Village)
6. Installing a new EMWIN satellite receiver at the new site for receipt of warnings and Emergency information and;

7. Reconditioning of the Stevenson screen unit;
8. Purchase and installation of a single phase mobile standby generator;
9. Training of local staff on use and maintenance of the equipment provided

The Vava'u works was carried out by the Director of Meteorology (Mr. 'Ofa Fa'anunu), NEMO Communications Officer (Mr. Paula Finau), Assistant Forecaster (Mr. Selusalema Vite) and Vava'u Meteorological Staff, OIC (Mr. Uili 'Ulingaholo) and two Meteorological Technician Grade 1 (Mr. Sitaniselao Waterhouse and Mr. Faingata'a Vaitaki).

2.0 Vava'u Meteorological Office Upgrade

Due to inadequate Office space to house the expanding Vava'u Meteorological Service (VMS) and the installation of new HF Equipment under the Tonga Early Warning System HF/RANET Project, the Ministry of Transport refurbished the Technical Workshop at Lupepau'u Airport and turned it into an Office.

The work was carried out by Saiti Joinery and Constructions Ltd. The work took three weeks in July 2008 to complete. The VMS is now housed in a more robust building built to withstand strong winds and adverse weather. Moreover, the re-location of the met instruments and antennae tower to areas free of obstructions enabled these observations to meet and comply with international specifications.

The refurbishment work included the sealing of an entrance, bathroom and toilet, rewiring electrical, bench and chairs, notice board and a paint job.

Also installed during the Vava'u works was an Emergency Managers Weather Information Network (EMWIN) satellite receivers. This equipment with was funded by the US National Ocean and Atmosphere Administration (NOAA) allows the VMS to receive meteorological products such as warnings and forecasts directly via satellite independent of phone lines. This makes the Vava'u Meteorological Office a secondary backup to the main forecasting centre in Fua'amotu.

The VMS are now able to receive observation data from throughout the Pacific region and various warnings put out from various regional warning centres.

3.0 HF/RANET System installation

This equipment was provided and funded by the Munich Re Foundation under the Tonga Early Warning Enabling Project (EURO50000) to install HF equipment at Met Headquarters, Vava'u Met, and Ha'apai Met. and the National Emergency Management Office (NEMO). The equipment installed in Vava'u included the following:

- 1 Power Supply
- 1 Single Phase Standby Generator
- 1 Factor Modem
- 1 Toshiba Dual Processor Laptop
- 1 Antennae mast
- 1 Single Wire Antennae
- 1 HF transceiver
- 1 Dummy Load Power monitor

The antennae mast is located just North East of the newly renovated Vava'u Meteorological Office together with the Met. Instrument enclosure.

After the installation of the HF radio at VMS, staff is now able to send observation data via both HF email (RANET) and voice to Fua'amotu head Office and the NEMO Office free of charge. At the same time, the Head Offices can send warnings, awareness materials and other information back to Vava'u Met., as required. It is envisaged that the RANET concept will move further in trying to get out warnings of disasters and address risk management to the grass root communities. VMS capability has been successfully upgraded to act as a standby station to Fua'amotu as required.

4.0 EMWIN Installation

The EMWIN system complements and operates in parallel with the HF RANET system to provide Vavau Met Service with a simple yet robust communication capability. System components are as follows;

- satellite receive dish
- a satellite receiver
- 30m coax cable
- a signal processor and;
- a personal computer (PC)

The PC was funded by the Government of Tonga from the Ministry of Transport (MOT).

5.0 Vaisala Digital Barometer Installation

The Vaisala PTB220 Digital Barometer was supplied under United Kingdom Assistance to weather Observations in the Pacific Islands (Rescue Pac. Project) through the Met Service of New Zealand Limited. Correction cards were supplied by the Met Service of New Zealand Limited. This Barometer replaces the old Kew Pattern Mercury Barometer which was installed in 1995.

6.0 Maintenance of Stevenson Screens

Restoration work was also carried out to repair the Vava'u Stevenson screen. Some parts including the stand have become affected by wood rot since its initial installation back in 1995. A full paint job was carried out as well.

7.0 Relocation of meteorological instrument enclosure

All basic meteorological observing equipment were also transferred from the old enclosure at the International terminal to the new location. The equipment transferred included the following:

- a Stevenson screen
- max, min, dry and wet thermometers
- an automatic rain gauge data logger
- a manual rain gauge and
- a antennae mast

8.0 Standby generator

A single phase Yamaha mobile Generator was purchased to power the Office and HF equipment during time of power disruptions e.g. tropical cyclones.

9.0 Installation of an automatic rain gauge

An automatic rainfall data logger was also installed on the eastern district of Vava'u at Tu'anekevile village. The gauge was installed at 'Ene'io Botanical Gardens. The owner Mr. Haniteli Fa'anunu upkeeps the gauge on a voluntary basis. The gauge was funded by US NOAA through the University of Oklahoma. It is anticipated that the gauge would help determine the rainfall distribution in Vava'u after a dataset is collected.

10.0 Training Programmes

Training of the Vava'u Meteorological Staff to operate and maintain all the equipment was carried out by the Director of Meteorology Mr. 'Ofa Fa'anunu over the last two weeks of the installation work.

Much emphasis went into detailed training on maintenance as it was deemed necessary for the sustainability of the project to have competent operators utilizing the equipment.

The topics covered during the training were:

- Basic Personal Computer (PC) operations/maintenance
- EMWIN operations/maintenance
- HF radio operations/maintenance
- AWS Rain Gauge care and maintenance
- Digital Barometer care and maintenance
- Satellite Dish and antennae mast maintenance
- Power usage and safety (including standby generator and equipment)
- Instrument enclosure care and maintenance

11.0 Funding

The costs of the HF Radio equipment, Standby Generator, installation tools and accessories, per diems for Mr. 'Ofa Fa'anunu (30days), Paula Finau (10days), Selusalema Vite (10days), shipping of equipment to Vava'u and fuel were all borne under the Munich Re Foundation RANET Early Warning Project.

The satellite receiver and automatic rain gauge were supplied under funding from US NOAA. The maintenance of the Office building, 1 PC, electricity, telephone, transport (vehicle) and logistics support was borne by the TMS and the Tonga Ministry of Transport. Table 1 provides an inventory of the equipment installed in the new office.

Table 1: Inventory of items installed in VMS new office

No.	Item	Serial No.	Status
1.	1 Single Phase Gasoline Fuelled Yamaha EF2600 Generator	N432 7CE-F4237-00	OK
2.	1 Icom IC-78 HF Transceiver and handset	Serial - 0027182	OK
3.	1 DSP Multimode PACTOR-Controller	EX29070100000E84A44BBF	OK
4.	1 Dummy Load/Wattmeter Model MF J-267		OK
5.	1 DC Regulated Power Supply Powertech MP3090	M170722416	OK
6.	1 Furon Blue and White PC for EMWIN	N/A	OK
7.	1 EMWIN Signal Processor ESP-96	N/A	Signal display loose
8.	1 Vaisala PTB220 Series Digital Barometer	C1040005	OK
9.	1 Duo Processor Toshiba Tecra Laptop and HP Optical mouse Operating System Windows XP Professional Product Key BTGF9-64WYM-CV87W-3VWMR-JJ9TW	97042582H	OK
10.	1 Stevenson screen	N/A	Needs Replacement loose door
11.	1 Sheathed Dry Bulb Thermometer	N/A	OK
12.	1 Sheathed Wet Bulb Thermometer	KER8007	OK
13.	1 Sheathed Maximum Thermometer	0703522	OK
14.	1 Sheathed Minimum Thermometer	Ref no. 21200 35947/61	OK
15.	1 Manual Rain gauge	N/A	Needs Replacement Rust

